

REMARKS/ARGUMENTS

The Applicants have carefully considered this Application in connection with the Examiner's Action and respectfully request reconsideration of this Application in view of the foregoing amendment and the following remarks.

The Applicants note with Appreciation the courtesies extended by the Examiner during the Applicant-Initiated Interview of April 8, 2008.

The Applicants originally submitted Claims 1-21 in the Application. Dependent Claim 12 is cancelled without prejudice or disclaimer, and incorporated into dependent Claim 11. Claims 1, 3-8, 10-15, and 17-23 are presently pending. Dependent Claim 24 is newly added in the present Amendment. Independent Claims 1, 8, and 15 are currently amended. Claims 1, 3-8, 10-11, 13-15, and 17-24 are currently pending.

I. Rejection of Claims 1, 8, and 15 and their dependent claims under 35 U.S.C. §112, First Paragraph

The Examiner has rejected previously presented Claims 1, 8, and 15 and their dependent claims under 35 U.S.C. §112, First Paragraph, for a recitation of "the plurality of redundant signals" in the claim language. Although the Applicants respectfully disagree with the propriety of the rejection, in the interests of furthering prosecution, the Applicants amend independent Claims 1, 8 and 15 to recite substantially "said bitstream including an aggregate signal resulting from a combination of a plurality of *diversity* signals..." Support for the present amendments may be found, among other places, in paragraph [0025] of the present Application,

wherein employment of a combiner that is a maximal ratio combiner is discussed ("MRC"), which is also disclosed by FIGs. 1 and 2.

As is understood by those of skill in the art, MRCs are generally used on diversity signals, as will be described. For instance, please see the entry in Wikipedia, the Free Encyclopedia: "Maximal-ratio combining: In telecommunications, maximal-ratio combining is a method of diversity combining ..." Also, please see "Diversity combining: Diversity combining is the technique applied to combine the multiple received signals of a diversity reception device into a single improved signal..." Furthermore, please see "Diversity Scheme: In telecommunications, a diversity scheme refers to a method for improving the reliability of a message signal by utilizing two or more communication channels with different characteristics..." These documents are included for reference in a "Supplemental Information Disclosure Statement", filed contemporaneously with this Amendment.

In the "Response to Arguments" section, the Examiner states:

The Applicant further argues that Marko fails to teach redundant signals are combined into an aggregate signal, and then delivered to a Wireless access point (WAP). However, the redundant signals are nowhere to be found in the specification." (See Examiner's Action, page 7.)

Therefore, this claim element was not considered in the previous Examiner's Action.

However, the Applicants state that Claim 1 as currently amended and previously presented, is supported by the current specification, as a Maximal Ratio Combiner can employ diverse signals as claimed in Claim 1. Therefore, the Applicants respectfully request that this claim element be considered by the examiner.

Furthermore, the MRC employs redundant signals, as is now claimed in dependent Claim 24 is supported by the disclosed by the document "Maximum Ratio Combining of Correlated

Diversity Branches with Imperfect Channel State Information and Colored Noise" by Lars Schmitt, *et al.*, referenced in the Supplemental Information Disclosure Statement filed contemporaneously herewith.

Therefore, the Applicants respectfully state that the above claim language is supported by the specification, and respectfully request that the Examiner withdraw the 35 U.S.C. §112, First Paragraph, rejection and allow these claims to issuance.

II. Rejection of Claims 1, 3-5, 8, 10-12, 15, 17-19 and 22-23 under 35 U.S.C. §103

The Examiner rejected Claims 1, 3-5, 8, 10-12, 15, 17-19 and 22-23 under 35 U.S.C. §103(a) as being unpatentable over U.S. Patent Publication 2005/0097053 to Aaltonen *et al.* ("Aaltonen") in view of U.S. Patent No. 7,123, 875 to Marko *et al.* ("Marko"). The Examiner has rejected Claims 6, 13, and 20 under 35 U.S.C. §103(a) as being unpatentable over U.S. Patent Publication 2005/0097053 to Aaltonen in view of Marko in further view of U.S. Patent No. 6,370,153 to Eng ("Eng"). The Examiner has rejected Claims 7, 14, and 21 under 35 U.S.C. §103(a) as being unpatentable over Aaltonen in view of Marko in further in view of U.S. Patent No. 6,370,153 to Chen ("Chen"). The Applicants respectfully disagree in view of the foregoing amendments and following remarks.

The Applicants respectfully state that neither Aaltonen nor Marko, either singularly or in combination, disclose or suggest a gateway configured to format a bitstream received from a broadcast receiver, the bitstream including an aggregate signal *resulting from a combination of a plurality of diverse signals*, as recited in Claim 1. (Emphasis added.) The Applicants will respectfully address the rejections of the Examiner regarding Marko.

The Examiner recognizes that Aaltonen fails to specifically teach a bitstream including an aggregate signal resulting from a combination of a plurality of signals. (*See Examiner's Action*, page 3.) However, regarding Claim 1, the Examiner cites to the secondary reference, Marko for the proposition that:

The SDAR receivers are designed to receive one or both of the satellite signals (i.e., mobile receivers are capable of simultaneously receiving signals from two satellites and one terrestrial repeater for combination, col. 2, lines 47-53) and the signals from the terrestrial repeaters and combine or select one of the signals as the receiver output, and the repeater (having feature to format bitstream) receives and retransmit the satellite signal (col. 3, line 13 to col. 4, line 30). (*See Examiner's Action*, page 4.)

Therefore, the Examiner contends that the above limitation is known in the art, and that Aaltonen is combinable with Marko.

The Applicants respectfully disagree with the Examiner for at least the following reasons. The cited art of Marko col. 2, lines 47-53 merely state that: "IF receivers are modified conventional satellite digital audio radio service receivers. A user interface is provide for each IF receiver to allow for channel selection and audio processing." The Applicants respectfully state that this citation appears to be directed toward satellite selection, not satellite signal aggregation. This citation does not disclose that the bitstream includes an *aggregate signal* resulting from *a combination of a plurality of diversity signals*...."

Please note that col.3 lines 13 to col. 4, line 30 of Marko, cited by the Examiner, discusses both the prior art as characterized by Marko and the detailed description of the invention of Marko. Col. 3, lines 13 to col. 4, line. 30 are directed to FIG. 2, which Marko recognizes as prior art, and FIG. 3. FIG. 2 receives a TDM of a terrestrial antenna 40 which broadcasts to a portable radio 20, which can also receive a signal from a satellite 12. In FIG. 3 a single satellite is received. However, neither of the cited passages of Marko disclose or suggest that the transmitted bitstream includes an

aggregate signal resulting from a combination of a plurality of diversity signals, as is claimed in Claim 1.

The Examiner also contends that Marko discloses “the repeater (having feature to format bitstream) receives and retransmits the satellite signal (col. 3, line 13 to col. 4, line 30)” as anticipating independent Claim 1. (See Examiner's Action, page 4.) However, the Applicants respectfully state that col. 3, line 13 to col. 4, line 30 of Marko does not disclose or suggest *combining a plurality of diverse signals*. Nor does the Examiner so expressly contend.

Indeed, Col. 5, lines 16-23 of Marko state, when discussing FIG. 5:

The output of the Reed-Solomon decoder 318 is provided via a terrestrial/satellite combiner 320 to the source decoder 400 for service layer decoding [within a SDARS receiver]. *In accordance with present teachings, the satellite A and B signals are not present, accordingly, the terrestrial/satellite combiner 320 is not required and is provided merely to show that a satellite digital audio radio receiver of conventional design may be utilized to practice the teachings of the present invention.* (Emphasis added.)

The Applicants respectfully submit that the combination of signals, esp. diverse signals, to create an aggregate signal for transmission is not enabled within Marko. Furthermore, there is a teaching away from the use of using a combined signals (“terrestrial/satellite combiner 320 is not required....”) Therefore, Marko is an inapposite reference, and should be withdrawn by the Examiner.

Furthermore, in Claim 1, diversity signals are *already* combined, such as by a Maximal Ratio Combiner, and are to be, and an aggregate signal received *after* being [re]transmitted by a client over a WLAN. This allows for the transmission of the combined aggregate signal in a bitstream over the WLANs. In Marko, the cited passage do not disclose or suggest delivery of a transmission of

bitstream including a combined aggregation of a diverse plurality of signals from a from over a WAP for a purpose of subsequent conversion by said WAP into a wireless transmission.

Regarding specific dependent claims, dependent Claim 22 is an embodiment of how the diversity signals are combined (*i.e.*, with use of a MRC). Regarding dependent Claim 22, the Examiner contends: "Marco further teaches said aggregate signal is generated by a maximal ratio combiner. (col. 15, lines 16-30.))" (*See Examiner's Action*, page 5.)

In Marko, col. 5, lines 16-29:

The output of the Reed-Solomon decoder 318 is provided via a terrestrial/satellite combiner 320 to the source decoder 400 for service layer decoding [within a SDARS receiver]. *In accordance with present teachings, the satellite A and B signals are not present, accordingly, the terrestrial/satellite combiner 320 is not required and is provided merely to show that a satellite digital audio radio receiver of conventional design may be utilized to practice the teachings of the present invention.* (Emphasis added.) The output of a combiner 320 is also provided to a TSCC memory 700. The memory 700 provides time-division demultiplexing configuration data to a channel decoder control unit 312. The channel decoder control unit 312 consists of a number of control and status registers and operates under control of the system controller 500.

In Marko the combiner 320 is a terrestrial/ satellite receiver, but no disclosure or suggestion that it is explicitly a "maximal ratio combiner".

Therefore, the Applicants respectfully state that a terrestrial/ satellite combiner 320 is not a maximal ratio combiner. Indeed, Marko disparages the use of a combiner, as emphasized above. The Applicants have not found within Eng or Chen a disclosure that compensates for the deficiencies of Aaltonen or Marko.

Aaltonen, individually or in combination with Marko, Eng, or Chen fails to teach or suggest the invention recited in independent Claim 1, and its dependent claims, when considered as a whole. For similar reasons, nor do the cited references support the Examiner's rejection of independent Claims 8 and 15, and their dependent claims, when considered as a whole.

Therefore, the Examiner has not provided a *prima facie* case of obviousness of Claims 1, 3-5, 8, 10-12, 15, 17-19 and 22-23 in view of Aaltonen and Marko, Eng, or Chen. The Applicants therefore respectfully request the Examiner withdraw the rejection and allow these claims to issue.

III. Conclusion

In view of the foregoing amendment and remarks, the Applicants now see all of the Claims currently pending in this Application to be in condition for allowance and therefore earnestly solicit a Notice of Allowance for Claims 1, 3-8, 10-11, 13-15, and 17-24.

The Applicants request the Examiner to telephone the undersigned attorney of record at (972) 480-8800 if such would further or expedite the prosecution of the present Application. The Commissioner is hereby authorized to charge any fees, credits or overpayments to Deposit Account 08-2395.

Respectfully submitted,

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A handwritten signature in black ink, appearing to read 'D. Hitt', with a stylized flourish at the end.

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Maximal-ratio combining

From Wikipedia, the free encyclopedia

In telecommunications, **maximal-ratio combining** is a method of diversity combining in which (a) the signals from each channel are added together, (b) the gain of each channel is made proportional to the rms signal level and inversely proportional to the mean square noise level in that channel, and (c) different proportionality constants are used for each channel. It is also known as **ratio-squared combining** and **predetection combining**. Maximal-ratio-combining is the optimum combiner for independent AWGN channels.

This article contains material from the Federal Standard 1037C (in support of MIL-STD-188), which, as a work of the United States Government, is in the public domain.

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Categories: Telecommunications stubs | Telecommunications terms

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Diversity combining

From Wikipedia, the free encyclopedia

Diversity combining is the technique applied to combine the multiple received signals of a diversity reception device into a single improved signal.

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Various Techniques

Various diversity combining techniques can be distinguished:

- Selection combining: Of the N received signals, the strongest signal is selected. When the N signals are independent and Rayleigh distributed, the expected diversity gain has been shown to be $\sum_{k=1}^N \frac{1}{k}$, expressed as a power ratio.^[1] Therefore, any additional gain diminishes rapidly with the increasing number of channels.
- Switched combining: The receiver switches to another signal when current signal drops below a predefined threshold. This is a less efficient technique than selection combining.
- Equal gain combining: All the received signals are summed coherently.
- Maximal-ratio combining: The received signals are weighted with respect to their SNR and then summed. The resulting SNR yields $\sum_{k=1}^N SNR_k$ where SNR_k is SNR of the received signal k .

Sometimes more than one combining technique is used -- for example, lucky imaging uses selection combining to choose (typically) the best 10% images, followed by equal gain combining of the selected images.

Switched combining two-way radio example

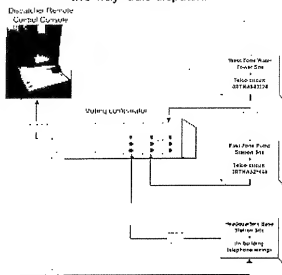
In land-mobile radio, where vehicle-mounted and hand-held radios communicate with a base station radio over a single frequency, space diversity is achieved by having several receivers at different sites. Diversity combining, or **voting**, in two-way radio systems is a method for improving talk-back range from walkie talkie and vehicular mobile radios.^[2]

The receivers are connected to a device referred to as a voting comparator or voter.

The voting comparator performs an evaluation of all received signals and picks the most usable received signal.^[3] In repeater systems, the voted signal is retransmitted. In simplex systems, it goes to the console speaker at the base station. Audio from the receivers that are not voted is ignored. Voting comparators in analog FM systems can switch between receivers in tenths- or hundredths-of-a-second, (faster than one syllable). So long as an intelligible signal gets to a single receiver in the system, the repeated audio, or audio sent to the console speaker, would be intelligible.

In this arrangement, receivers at remote sites are connected to the voting comparator by private telephone lines, a channel in a D4 channel bank on a DS1, or an analog microwave baseband channel.

Example of a basic three-site diversity combining (voting) system used in two-way radio dispatch.



System diagram for a water utility two-way radio system with voting.

How signals are evaluated

The earliest voting comparators relied on a tone encoded on a separate audio path, requiring each receiver site to have a 4-wire circuit or two audio paths. The pitch of the tone changed to represent the received signal level, or FM receiver limiter voltage, at the remote receiver. This worked poorly because it did not account for microwave baseband noise or noisy telephone company circuits.

Newer voting comparators compare signal-to-noise ratio at the voting comparator, accounting for end-to-end noise, bad phone lines, poor level discipline, as well as the best diversity reception path.

Walkie talkie talk-back range

When communicating with hand-held radios, base stations generally talk out further than they can receive. Voting among several receivers at different sites increases the probability that one of the receivers will acquire a usable signal from two-way radios in a system.

Interference reduction

Diversity combining reduces one possible single-point failure: any single receiver failure, or local interference to a single receiver, will not block reception on the entire system. Equipment sites can host many radio transmitters and receivers.^[4] A single site is subject to local, site-specific interfering signals. These interfering signals may come and go as transmitters switch on and off.

A potential problem with receivers located at high-elevation receiver sites is that they may acquire signals from distant counties, prefectures, or other provinces. These unwanted, distant signals can be stronger than desired signals from local walkie talkies.^[5] The distant signals may block local weak signals in some cases. Having several receive sites increases the probability that one of the sites will receive the

local signal in the presence of a distant, undesired one.^[6] Selective calling can eliminate users having to listen to the audio of distant signals even though the distant signals are within receive range of one or more receivers.

Coverage

A minimum of 95% coverage is cited in literature for critical or emergency service two-way radio systems.^[7] One definition of system coverage is Telecommunications Industry Association (TIA) TSB-88A standard.^[8]

Vote-lock or vote-and-hold option

The majority of installations using diversity combining equipment continually evaluate the best received signal against all other signals. Throughout the length of a received transmission, the comparator may switch receivers as often as every few tenths of a second. As a walkie talkie user causes a signal fade by turning their head, or a passing tractor-trailer rig blocks their signal at the voted receive site, the combining unit rapidly changes to a different receiver.^[9]

In some installations, diversity combining equipment is configured to lock on a receiver. For example, in some rural, regional coverage systems, the receivers each cover a unique geographic area. There is not much overlap. If the system consisted of two sites, north and south, it would pick the best of the two and remain locked on that receiver until the transmission ended.^[10] This works better with mobile radios because their signal strengths tend to be steady.^[11]

In some cases this vote-and-hold is used to steer transmitter selection. Consider the case of a regional system with two base stations: north and south. If the diversity combining equipment votes "north," the next time the dispatcher presses the transmit button, the north transmitter will key. Called *transmitter steering*, this is supposed to automate transmitter selection in systems where more than one transmitter site is available. In some instances it doesn't work well.^[12]

In mobile data systems, the vote lock option is preferred because constant switching between receivers causes lost data packets. The diversity combining equipment switches fast enough that syllables are not lost but not fast enough that bits are not lost. Mobile data systems usually originate with modems in mobile radios. Mobile radios usually produce solid signals into more than one receive site, so the signal strengths are strong enough for vote locking to work well.^[13]

References

- ¹ ^ D.G. Brennan, "Linear diversity combining techniques," *Proc. IRE*, vol.47, no.1, pp.1075–1102, June 1959
- ² ^ To confirm the use of the word *voting* to describe this equipment, see US Patent and Trademark Office patent ID 4531235 and 5884192 "Diversity Combining for Antennas."
- ³ ^ "Section V: Conclusions," *The California Highway Patrol Communications Technology Research Project on 800 MHz, 80-C477*, (Sacramento, California: Department of General Services, Communications Technology Division, 1982.) pp. V-6.
- ⁴ ^ For example, one specific equipment site is described as having six base stations and many receivers. See: "3.1.3 Draper Lake Radio Site," *Trunked Radio System: Request For Proposals*, (Oklahoma City, Oklahoma: Oklahoma City Municipal Facilities Authority, Public Safety Capital Projects Office, 2000) pp. 56.
- ⁵ ^ One rule of thumb is that a walkie talkie transmitter produces one-tenth (-10 db) to one-hundredth (-20 db) of the signal levels of vehicular radios at the base station receiver.
- ⁶ ^ "Evaluating Regional Alternatives: Site Selection," *Planning Emergency Medical Communications: Volume*

2. *Local/Regional Level Planning Guide*, (Washington, D.C.: National Highway Traffic Safety Administration, US Department of Transportation, 1995) pp. 52-55.
7. ^ "Evaluating Regional Alternatives: Site Selection," *Planning Emergency Medical Communications: Volume 2, Local/Regional Level Planning Guide*, (Washington, D.C.: National Highway Traffic Safety Administration, US Department of Transportation, 1995) pp. 52. A professional consultant should help in coverage definitions for engineered systems because "95% coverage" can be interpreted many different ways.
8. ^ Coverage definitions for engineered systems are described in *California EMS Communications Plan: Final Draft*, (Sacramento, California: State of California EMS Authority, September 2000), and, "Glossary," *Arizona Phase II Final Report: Statewide Radio Interoperability Needs Assessment*, (Phoenix, Arizona: Macro Corporation and The State of Arizona, 2004), pp. 165.
9. ^ For one description of a system in operation, see: "2.1 Mobile Radio System," *San Rafael Police Radio Committee: Report to Mayor and City Council*, (San Rafael, California: City of San Rafael, 1995,) pp. 4.
10. ^ For a discussion of vote locking versus conventional voting, see: "Section V: Conclusions," *The California Highway Patrol Communications Technology Research Project on 800 MHz, 80-C477*, (Sacramento, California: Department of General Services, Communications Technology Division, 1982,) pp. V-6. The report says California Highway Patrol does not use vote locking in Los Angeles, a very congested radio environment. In some interference conditions, vote locking can produce poor results. The first voted site is sometimes not the best site. Some sites have elevated ambient noise levels causing them to continually be voted last, even though they produce marginally better audio and their ability to maintain a path to the mobile over a long transmission may be better.
11. ^ An extreme case: one California study describes a field test where the received signal level from a 90-watt, 42 MHz. mobile radio dropped from 45 microvolts (a solid signal) to nothing in one driving mile of road. See: "Section II: Radio Propagation Studies," *The California Highway Patrol Communications Technology Research Project on 800 MHz, 80-C477*, (Sacramento, California: Department of General Services, Communications Technology Division, 1982,) pp. V-6.
12. ^ The existence of *vote-and-hold* and its use in transmitter steering can be confirmed by reading, "Section V: Conclusions," *The California Highway Patrol Communications Technology Research Project on 800 MHz, 80-C477*, (Sacramento, California: Department of General Services, Communications Technology Division, 1982,) pp. V-6.
13. ^ Service manuals for diversity combining equipment designed for use with mobile data will describe this in detail.

See also

- Diversity schemes
- Transmit diversity
- Antenna diversity
- Aperture synthesis
- Cooperative diversity

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Diversity scheme

From Wikipedia, the free encyclopedia

In telecommunications, a **diversity scheme** refers to a method for improving the reliability of a message signal by utilizing two or more communication channels with different characteristics. Diversity plays an important role in combating fading and co-channel interference and avoiding error bursts. It is based on the fact that individual channels experience different levels of fading and interference. Multiple versions of the same signal may be transmitted and/or received and combined in the receiver. Alternatively, a redundant forward error correction code may be added and different parts of the message transmitted over different channels. Diversity techniques may exploit the multipath propagation, resulting in a diversity gain, often measured in decibels.

The following classes of diversity schemes can be identified:

- **Time diversity:** Multiple versions of the same signal are transmitted at different time instants. Alternatively, a redundant forward error correction code is added and the message is spread in time by means of bit-interleaving before it is transmitted. Thus, error bursts are avoided, which simplifies the error correction.
- **Frequency diversity:** The signal is transferred using several frequency channels or spread over a wide spectrum that is affected by frequency-selective fading. Middle 20th century microwave radio relay lines often used several regular wideband radio channels, and one protection channel for automatic use by any faded channel. Later examples include:
 - OFDM modulation in combination with subcarrier interleaving and forward error correction
 - Spread spectrum, for example frequency hopping or DS-CDMA.
- **Space diversity:** The signal is transferred over several different propagation paths. In the case of wired transmission, this can be achieved by transmitting via multiple wires. In the case of wireless transmission, it can be achieved by antenna diversity using multiple transmitter antennas (transmit diversity) and/or multiple receiving antennas (**diversity reception**). In the latter case, a diversity combining technique is applied before further signal processing takes place. If the antennas are at far distance, for example at different cellular base station sites or WLAN access points, this is called **macrodiversity**. If the antennas are at a distance in the order of one wavelength, this is called **microdiversity**. A special case is phased antenna arrays, which also can be utilized for beamforming, MIMO channels and Space-time coding (STC).
- **Polarisation diversity:** Multiple versions of a signal are transmitted and received via antennas with different polarization. A diversity combining technique is applied on the receiver side.
- **Multiuser diversity:** Multiuser diversity is obtained by opportunistic user scheduling at either the transmitter or the receiver. Opportunistic user scheduling is as follows that the transmit selects the best user among candidate receivers according to qualities of each channel between the transmit and each receiver. In FDD systems, a receiver must feed back the channel quality information to



Terrestrial microwave radio system with two antenna arrays configured for space-diversity

the transmitter with the limited level of resolution.

- **Antenna diversity**: transmitted along different propagation paths.
- **Cooperative diversity**: enables to achieve the Antenna diversity gain by the use of the cooperation of distributed antennas belonging to each node.

See also

- Space-time coding (STC)
- Antenna diversity
- Macrodiversity
- Diversity combining
- Aperture synthesis
- Cooperative diversity
- Channel access method
- Fresnel zone
- Tropospheric scatter

External links

- Diversity reception - Background information of the development of Diversity reception devices.

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